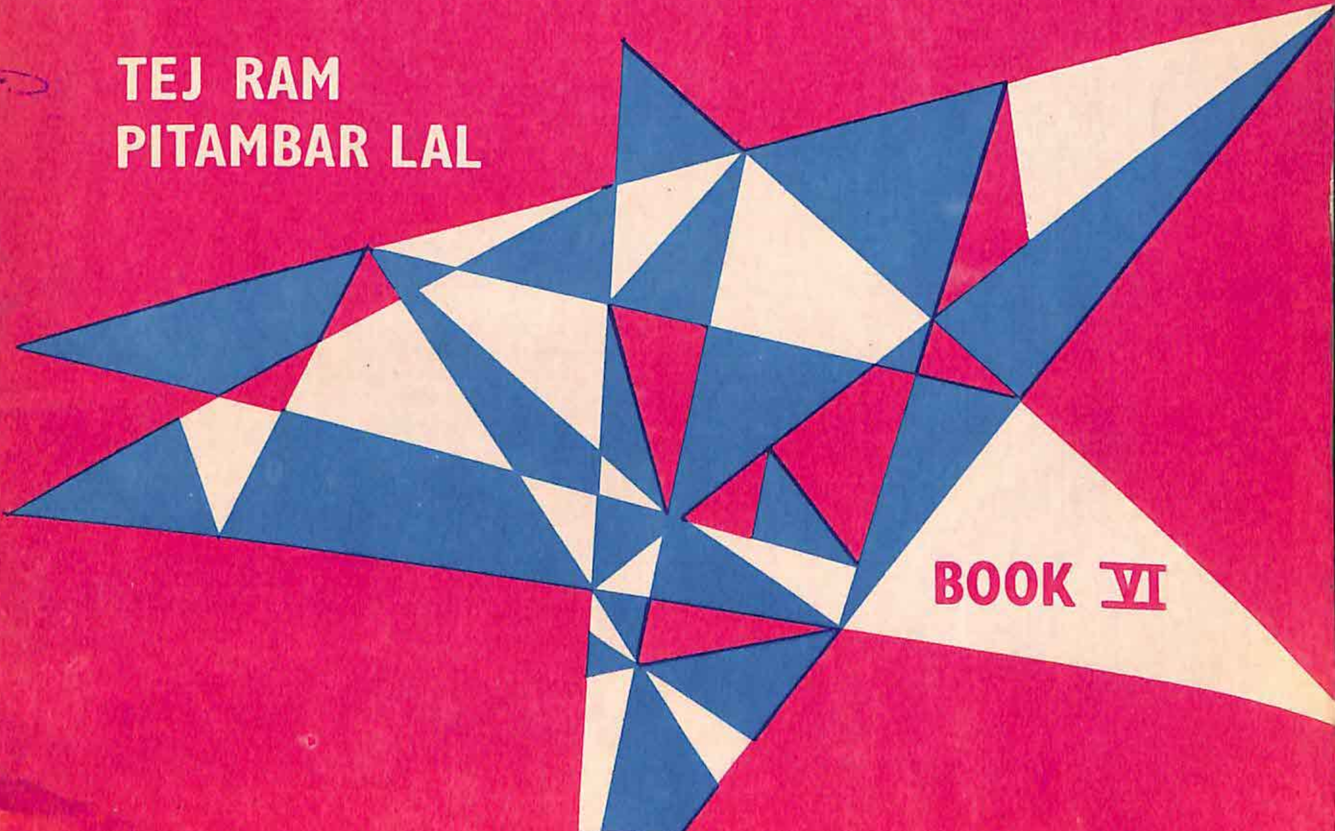
A NEW SCHEME

ALGEBRA

TEJ RAM
PITAMBAR LAL



BOOK VI

PITAMBAR PUBLISHING COMPANY

A
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By

TEJ RAM, *M.A.*

&

PITAMBAR LAL, *M.A.*

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PREFACE

We take great pleasure in presenting to the young students this series of books on Algebra. The dearth of suitable books in the market with Indian background encouraged us to write the present series. In preparing this series our chief aim has been to present the principles of the subject in a most easy-to-understand and easy-to-work out manner. The subject matter has been presented in a very lucid manner and the language is easy.

Throughout the book the sound principle of taking difficulties one at a time has been strictly followed. Typical examples of almost every variety have been solved and in the ensueing exercises questions based on these examples have been set. Particular care has been taken in the classification and gradation of the subject matter.

The answers given at the end of the book have been checked twice.

It is hoped that these books will meet the needs of the students for whom they are meant.

Corrections and suggestions for improvement will be thankfully received.

—Authors

PREFACE TO THE REVISED EDITION

We are very pleased to lay before the reading public the most popular book in the subject in a new fascinating format. In the revised edition, opportunity has been taken to weed out some misprints of the original edition.

We hope the new edition will find an even better response from the readers.

—Publishers

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CHAPTER I

Use of Signs and Symbols. Fundamental Rules

1. **Arithmetic.** It is a branch of the science that treats of numbers. In Arithmetic these numbers are expressed by means of digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. You know methods of using these numbers.

2. **Algebra.** Like Arithmetic, it is a branch of the science that treats of numbers. In addition to these numbers we use the letters such as a, b, c, ...l, m, n,........p, q, r, ...x, y, z which also express numbers.

3. The digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, used in Arithmetic and Algebra have a *single fixed value*. But the letters a, b, c, l, m, n....do not have a single fixed value. They can have *any values*.

Ram paid *Rs* 7 for his bat. So he paid a definite price for the bat. Suppose Ram paid *Rs* x for his bat. Now we may think of *Rs* 5 or *Rs* 12, or *Rs* 9 or any number of rupees.

4. In Algebra we generally use letters and therefore we call it **Literal Arithmetic.**

In Arithmetic we use the digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, which have a fixed value but in Algebra the letters, a, b, c,....l, m, n,........x, y, z, may have **any general** value. Thus Algebra may also be called **Generalized Arithmetic**.

The letters a, b, c, l, m, n, x, y, z, etc., in Algebra merely denote numbers. 1, 2, 3, etc., are numbers ; but *Rs* 8, 6 *cm*, or 89 *kg* are quantities. Similarly x *km* stands for a quantity and x stands only for a number. Thus *to denote quantities in Algebra the unit must be written along with the letters.*

5. **Signs in Algebra**

+ is the sign of **addition**. It is read **plus** or **increased by** or **added to.**

– is the sign of **minus**. It is read **minus** or **diminished by.**

× is the sign of **multiplication**. It is read **into** or **multiplied by.**

Note. A small dot placed *below* and between two numbers also serves the purpose of the sign of multiplication *e.g.*, 6.3 means 6×3.

÷ is the sign of **division**. It is read **divided by** or **over** or **upon.**

= is the sign of **equality**. It is read "**equal to**" or "**equals**".

$\sim$ stands for "**difference between**".

$>$ stands for "**greater than**".

$<$ stand for "**less than**".

$\neq$ stands for "**not equal to**".

$\therefore$ stands for "**therefore**".

$\because$ stands for "**because**" or "**since**".

Ex. 1. Re-write the following, using symbols :

(*i*) a plus b. (*ii*) x minus y.

(*iii*) p into q. (*iv*) x divided by seven.

(*v*) l is greater than m. (*vi*) r is less than s.

Sol.

Questions	*Answers*
(*i*) a plus b	$a+b$
(*ii*) x minus y	$x-y$
(*iii*) p into q	$p\times q$
(*iv*) x divided by seven	$x\div 7$
(*v*) l is greater than m	$l>m$
(*vi*) r is less than s	$r<s$

Ex. 2. Write in signs and symbols the following :

(*i*) x diminished by y, (*ii*) l and m together equal n, (*iii*) a and b are unequal, (*iv*) twice the product of p and q, (*v*) Since 6 times a equals 48, therefore a equals 8, (*vi*) Difference between x and y.

Sol. (*i*) $x-y$. (*ii*) $l+m=n$. (*iii*) $a\neq b$. (*iv*) $2pq$.
(*v*) $\because 6a=48$. $\therefore a=8$. (*vi*) $x\sim y$.

Exercise 1

Re-write the following, using symbols :

1. (*i*) Seven plus five. (*ii*) x plus y.
(*iii*) Eight increased by three. (*iv*) a increased by b.
(*v*) One added to eight. (*vi*) l added to m.

2. (*i*) Five minus three. (*ii*) x minus y.
(*iii*) Ten diminished by three. (*iv*) l diminished by m.
(*v*) Two subtracted from eight. (*vi*) p subtracted from q.

3. (*i*) Eight taken from fourteen. (*ii*) a taken from b.

4. (*i*) Five plus eleven minus nine. (*ii*) a plus b minus c.

5. (*i*) Seven plus four plus two. (*ii*) l plus m plus n.

6. (*i*) Fourteen minus one minus two. (*ii*) x minus l minus m.

7. (*i*) Nine multiplied by six. (*ii*) p multiplied by q.

8. (*i*) Fifteen into two. (*ii*) a into b.

9. (*i*) Twenty-one divided by seven. (*ii*) x divided by y.
10. (*i*) Seven upon five. (*ii*) l upon m.
11. (*i*) Eight over eleven. (*ii*) p over q.
12. (*i*) Four times five equals twenty. (*ii*) Four times x equals y.
13. (*i*) Seven into four divided by two. (*ii*) x into y divided by z.
14. (*i*) Eight is greater than two. (*ii*) l is greater than m.
15. (*i*) Twelve is less than two times fourteen.
(*ii*) p is less than twice q.
16. (*i*) Eight is not equal to ten. (*ii*) a is not equal to b.
17. (*i*) Three times five is not equal to eighteen.
(*ii*) Three times p is not equal to q.
18. (*i*) Five plus seventeen minus twelve is equal to ten.
(*ii*) a plus b minus x is equal to y.
19. Eleven times l divided by m equals p.
20. Twice the product of a and b over the sum of x and y.
21. Since five times x equals twenty, therefore, x equals four.
22. The sum of p and q divided by a.
23. The difference of x and y is less than the sum of p and q.
24. Twice p plus q into r minus s.
25. p upon q is greater than x.

Ex. Write the following in words :

(*i*) $l-m+n$. (*ii*) $\frac{xy}{z}$. (*iii*) $50x-p=q$. (*iv*) $a<b<c$.

Sol.

Questions	*Answers*
(*i*) $l-m+n$	**l minus m plus n.**
(*ii*) $\frac{xy}{z}$	**x into y over z.**
(*iii*) $50x-p=q$	**Fifty times x minus p equals q.**
(*iv*) $a<b<c$.	**a is less than b, b is less than c.**

Exercise 2

State the following in words :

1. (*i*) $5+4$. (*ii*) $l+m$. **2.** (*i*) $2-3+4$. (*ii*) $a-b+c$.
3. (*i*) $6-2$. (*ii*) $x-y$. **4.** (*i*) 5×4. (*ii*) $p\times q$.
5. (*i*) 7.9. (*ii*) $l.m$. **6.** (*i*) $9-2-5$. (*ii*) $p-q-r$.

7. (*i*) $\frac{2}{3}$. (*ii*) $\frac{p}{q}$ **8.** (*i*) $2\div 9$. (*ii*) $x\div y$.

9. (*i*) $4\times\frac{1}{3}$. (*ii*) $a\times\frac{1}{b}$. **10.** (*i*) $2\times 3\div 5$. (*ii*) $p\times q\div r$.

11. (*i*) $\frac{5\times 3}{2}$. (*ii*) $\frac{p\times q}{r}$. **12.** (*i*) $5\times\frac{2}{7}$. (*ii*) $a\times\frac{b}{c}$.

13. (*i*) $7>2$. (*ii*) $x>y$. **14.** (*i*) $5<9$. (*ii*) $a<b$.

15. $\because 5x=25$. $\therefore x=5$. **16.** (*i*) $3\times 6=18$. (*ii*) $a\times b=c$.

17. $a<b<c$. **18.** $p>q>r$. **19.** abc.

20. $\frac{ab+bc+ca}{2}$. **21.** $\frac{lm-pq}{xy+ab}$. **22.** $pq\times\frac{t}{h}$.

23. $2p-q\times r\div s$. **24.** $\frac{l}{m}>\frac{p}{q}$.

---

6. Now you have learnt how to express given statements in symbols. Let us consider the following :

$l+m$ means that the numerical value of l is to be added to the numerical value of m. If the numerical value of l be 15 and that of m be 5 then the numerical value of $l+m$ will be $15+5$ *i.e.*, 20.

Similarly if l represents 31 and u represents 17, then $l+m$ represents $31+17$ *i.e.*, 48.

$l-m$ means that the numerical value of m is to be subtracted from the numerical value of l. Thus if l represents 25 and m represents 9, then $l-m$ represents $25--9$ *i.e.*, 16.

Similarly if l represents 15 and m represents 10, then $l-m$ represents $15-10$ *i.e.*, 5.

$l\times m$ means that the numerical value of l is to be multiplied by the numerical value of m. Thus if l represents 9 and m represents 7, then $l\times m$ would represent 9×7 *i.e.*, 63.

Thus 9.7 means 9×7. Notice that the dot which denotes the sign of **multiplication is written below, and not above as the decimal point is written.**

In Algebra $l\times m$ may be written lm *i.e.*, the sign of multiplication may be omitted. Also $5\times a$ may be written $5a$. But remember that in Arithmetic sign of multiplication cannot be omitted *e.g.*, 7×9 cannot be written as 79 for 7×9 means 63 (sixty-three) while 79 means $70+9$ *i.e.*, (seventy-nine).

When 9 is multiplied by 7 the result or the product is 63. The **product** is a result of multiplying two or more numbers. The product of l and m may be written $l \times m$ or lm or ml.

$l \div m$ means that the numerical value of l is to be divided by the numerical value of m. Thus, if l represents 57 and m represents 19, then $l \div m$ represents $57 \div 19$ *i.e.*, 3.

$l \div m$ can also be written as $\frac{l}{m}$.

Note. You have read that $l \times m = lm$.

But the sign of multiplication cannot be omitted when it occurs in combination with $\div$

e.g., $n \div l \times m$ cannot be written as $n \div lm$,

for $n \div l \times m$ means $\frac{n}{l} \times m$

while $n \div lm$ means $\frac{n}{lm}$.

$l - m = n$ means that the numerical value of $l - m$ is equai to the numerical value of n. Thus if l represents 7 and m represents 5 then n would represent $7 - 5$ *i.e.*, 2.

You are to find $l \sim m$ when $l = 6$ and $m = 9$, then "$l \sim m$" means $m - l$ (or $9 - 6$). If $l = 8$ and $m = 6$, then "$l \sim m$" means $l - m$ (or $8 - 6$) *i.e.*, always the smaller number is to be subtracted from the greater number.

$l > m$ means that the numerical value of l is greater than the numerical value of m.

$l < m$ means that the numerical value of l is less than the numerical value of m.

$l \neq m$ means that the numerical value of l is not equal to the numerical value of m.

Ex. Answer the following questions :

(*a*) Can the sign of multiplication be omitted in :

(*i*) 5×4. (*ii*) $l \times m$?

(*b*) What is the difference between :

(*i*) 45 and 54. (*ii*) pq and qp ?

Ans. (*a*) (*i*) No. (*ii*) Yes. (*b*) (*i*) 9. (*ii*) No difference.

Exercise 3

1. Can the sign $\times$ be omitted in the following :

(*i*) 3×8. (*ii*) $5 \times a$. (*iii*) $p \times q$.

(*iv*) $5 \times 6 \times 7$. (*v*) $4 \times x$. (*vi*) $x \times y \times z$.

2. Find the difference between 9×8 and 98.
3. Find the difference between $a \times b$ and ab.
4. What is the difference between 65 and 56 ?
5. What is the difference between lm and ml ?
6. Distinguish between $l \div mn$ and $l \div m \times n$.

---

7. Substitution.

In Algebra, generally, we are to substitute numerical values in place of letters, a, b, c, etc. This method is known as the method of **Substitution.** We shall solve a few simple examples to illustrate this method.

Ex. 1. Find the value of $x-y$, if $x=15$ and $y=8$.

Sol. Here $x=15$, $y=8$

$$x-y=15-8=7. \qquad \textit{Ans.}$$

Ex. 2. Find the value of $5a+8b$, if $a=3$ and $b=5$.

Sol. Here $a=3$, $b=5$

$$5a+8b=5 \times a+8 \times b=5 \times 3+8 \times 5$$
$$=15+40=55. \qquad \textit{Ans.}$$

Ex. 3. If $p=3$, $q=4$ and $r=5$; find the value of $3p-4qr+25pq$.

Sol. Here $p=3$, $q=4$, $r=5$

$$3p-4qr+25pq=3 \times 3-4 \times 4 \times 5+25 \times 3 \times 4$$
$$=9-80+300=309-80=229. \qquad \textit{Ans.}$$

Ex. 4. If $l=5$, $m=6$ and $n=2$, find the value of $\dfrac{21l-5n}{2mn-l}$.

Sol. Here $l=5$, $m=6$, $n=2$

$$\frac{21l-5n}{2mn-l}=\frac{21 \times l-5 \times n}{2 \times m \times n-l}$$

$$=\frac{21 \times 5-5 \times 2}{2 \times 6 \times 2-5}=\frac{105-10}{24-5}=\frac{95}{19}=5. \qquad \textit{Ans.}$$

Exercise 4

1. Find the value of $a+b$ when

   (*i*) $a=8, b=3$.   (*ii*) $a=\frac{5}{2}, b=1\frac{1}{2}$.
   (*iii*) $a=12, b=9$.   (*iv*) $a=3\frac{1}{2}, b=7\frac{1}{2}$.

2. Find the value of $l-m$, when

   (*i*) $l=20, m=18$.   (*ii*) $l=8, m=3$.   (*iii*) $l=18, m=0$.

3. What value will $p \times q$ have when

(*i*) $p=5, q=3$; (*ii*) $p=28, q=0$;
(*iii*) $p=18, q=2$; (*iv*) $p=3, q=1$?

4. Evaluate $x \div y$ if

(*i*) $x=8, y=2$, (*ii*) $x=5, y=1$;
(*iii*) $x=50, y=25$; (*iv*) $x=18, y=9$.

5. If $x=21, y=3, z=8$; find the value of :

(*i*) $x+z$. (*ii*) $x-y$ (*iii*) $x+y-z$.
(*iv*) $x \times y$. (*v*) $\frac{y \times z}{x}$. (*vi*) $\frac{x-y}{z}$

6. If $l=8, m=5, n=3$; find the value of :

(*i*) $lm+mn+nl$. (*ii*) $ln-mn$.
(*iii*) $\frac{l+m-n}{l}$. (*iv*) $\frac{3l+2n}{3m}$.

7. If $x=3, y=2, z=0$, find the value of :

(*i*) $3xy$, (*ii*) $5xy-yz+2xz$.

8. If $a=2, b=3, c=8$, find the value of :

(*i*) $\frac{3abc-3bc}{2ab}$. (*ii*) $\frac{a+3b}{2c}$.

9. If $l=12, m=18$ and $n=25$, find the value of :—

(*i*) $\frac{l+mn}{2l}$. (*ii*) $l \div m \times n$.

10. If $x=10, y=8\frac{1}{2}, z=24$; find the value of—

(*i*) $\frac{3x+2y}{z}$. (*ii*) $\frac{x+yz}{2x}$.

---

8. Def. When two or more quantities are multiplied together the result is called the **product**. Thus the product of 5×4 is 20.

Each of the quantities multiplied together to form a product is said to be the **factor** of that product. Thus the factors of the product pxy are p, x, y. Similarly the factors of the product $15lm$ are 3, 5, l, m.

9. Algebraic expression

When some figures and letters are written together connected by the signs +, −, ×, ÷ the whole is called an **algebraic expression** or briefly an **expression.**

Terms. The parts of an expression connected by the signs $+$ or $-$ are called **terms** of the expression.

The expression $5-a\times b+c\div n$ contains three terms 5, $a\times b$, $c\div n$.

Note. The terms are not separated by the signs $\times$ and $\div$.

Thus $a\times b$ is one term,

and $c\div n$ is one term.

Simple expression. An expression which contains only one term is called a **simple expression** or a **Monomial.** Thus $9x$, $4bc$, $a\times b$, $a\div c$ are all simple expressions.

Compound expression. An expression which contains more than one term is called a **compound expression.** Thus $2a+5b$, $3a+7b-9c$, $9l-4m+2n$ are all compound expressions.

An expression which contains two terms is called a **Binomial.**

Thus $2a+5b$ is a binomial.

An expression which contains three terms is called a **Trinomial.**

See that $3a+7b-9c$ is a trinomial.

Co-efficient A term may have several factors. The number part of any term is called the *numerical coefficient*. Thus in the $7x$, 7 is the numerical coefficient of x. In $9xy$, 9 is the numerical co-efficient of xy.

When the numerical co-efficient is 1, it is omitted *e.g.*, $1ab$ is expressed as ab. Thus the numerical co-efficient of xyz is 1.

Sometimes it is convenient to consider any factor, or factors, of a product as the co-efficient of the remaining factors. Thus in the product $7xy$, $7x$ may be considered as the co-efficient of y. A co-efficient which involves symbols a, b, c x, y, z, etc., is called a **literal co-efficient.**

10. Like and Unlike Terms.

Terms which have the same letters (though they may have different numerical co-efficients) are called **like terms.**

Thus $5ab$ and $7ab$ are like terms.

Similarly $9\,lm$ and $15ml$ are like terms. $[\because lm=ml]$.

Terms which have different letters are called **unlike terms.**

Thus $7bcd$ and $7cad$ are unlike terms.

Similarly $19xyz$ and $51xyl$ are unlike terms.

Note. Like terms may have unlike signs. Thus $3ab$ and $-7ab$ are like terms.

Ex. Select the like terms in the expression : $5a-7ab+12bca-3abc+2a+19ba$.

Sol. $5a$ and $+2a$ are like terms.

$-7ab$ and $+19ba$ are like terms. $[\because 19ba=19ab]$

$+12bca$ and $-3abc$ are like terms. $[\because -3abc=-3bca]$

Exercise 5

(*i*) Find the numerical co-efficient of a in $5a$, $11a$, $17a$, $20a$, a.

(*ii*) Find the numerical co-efficient of ab in ab, $15ab$, $22ab$, $100ab$.

(*iii*) Find the numerical co-efficient in $4abc$, lmn, $2tny$, $5kmh$.

2. Separate the terms in the following expressions and say how many terms each expression contains :

(*i*) $a+b$. (*ii*) $a-b$ (*iii*) $a\times b+c$ (*iv*) $a+b-c$.
(*v*) $a\div b-c\times d$. (*vi*) $a-b-c+d$.

3. Which of the following expressions are simple and which compound :

(*i*) $l\times t$. (*ii*) $l+t$. (*iii*) $5a\times b$ (*iv*) $5a+b$
(*v*) $a\times b\div c$. (*vi*) $a+b-c$.

4. Which of the following expressions are binomials and which are trinomials :

(*i*) $a+b\times c$. (*ii*) $a\div b-c$. (*iii*) $a+b+c$
(*iv*) $a-b-c$ (*v*) $a\times c-b$ (*vi*) $a+c\div b$.

5. Select like terms in the following expressions :

(*i*) $a+b+4a+c-3a$ (*ii*) $ab-bc-ca-9bc$.
(*iii*) $4mnh+7nml-9hnm+11mln$ (*iv*) $l+lm-l+ml-4l$.

---

11. Power and Index

If in a product the same factor is repeated a certain number of times, the product is called the **power** of that factor. It is expressed by writing the number of factors to the right of the factor and above it. Thus

$5\times5=5^2$, and is called the second power of 5,
$5\times5\times5=5^3$, and is called the third power of 5,
$5\times5\times5\times5=5^4$, and is called the fourth power of 5, and so on.

In a similar way,

$x\times x=x^2$, and is called the second power of x,
$x\times x\times x=x^3$, and is called the third power of x,
$x\times x\times x\times x=x^4$, and is called the fourth power of x, and so on.

The number which shows the power of any factor is called its **index** or **exponent**. Thus 2, 3, 4, are the indices of x^2, x^3, x^4 respectively.

Note 1. x^2 is read "x squared" or "x to the second power", x^3 is read as "x cubed" or "x to the third power", x^4 is read "x to the fourth power" or "x to the fourth" and so on.

Note 2. The first power of x is x^1. But x^1 is generally written as x, the small digit 1 being omitted.

Note 3. "Indices" is the **plural** of "Index".

Caution. x^3 does not mean that x is to be multiplied by itself twice. "x multiplied by itself twice" means $x \times x \times x$ or x^3. But x^2 means "product of two x's" *i.e.*, $x \times x$.

Ex. 1. What is the difference between $5x$ and x^5 ?

Sol. $5x$ means the product of 5 and x *i.e.*, $5x=5\times x$.

x^5 means the fifth power of x or the product of 5x's *i.e.*, $x^5=x\times x\times x\times x\times x$. *Ans.*

Ex. 2. Distinguish between $5x^3$ and $3x^5$ when $x=2$.

Sol. $5x^3=5\times x\times x\times x=5\times 2\times 2\times 2=40.$

$3x^5=3\times x\times x\times x\times x\times x=3\times 2\times 2\times 2\times 2\times 2=96.$ *Ans.*

Exercise 6

If $a=2$, $b=5$, $c=3$, find the value of :—

1. $2b^2$.
2. a^2b^2.
3. a^2bc^3.
4. $3a^3b^2c$.
5. ac^5.
6. $\frac{a^2bc^4}{5}$.

If $l=3$, $m=6$, $n=2$, find the value of :

7. $\frac{l}{l^2}$.
8. $\frac{m}{n^2}$.
9. $\frac{n^3}{m^2}$.
10. $\frac{nl^2}{m^3}$.
11. $\frac{5nm}{l^5}$.
12. $\frac{6^2m^2l^3}{7n^4}$.

If $x=3$, $y=4$, $z=5$, find the value of :

13. x^2.
14. 2^x.
15. x^y.
16. $3z^x$.
17. xy^z.
18. $8x^zy^2$.
19. What is the difference between x^2 and $2x$?
20. What is the difference between $3x^4$ and $4x^3$?
21. Distinguish between "three times x" and "x cubed". Write down their values when $x=5$.
22. Distinguish between "5 times p cubed" and "thrice p to the fifth power" ; and write down their values when $p=2$.

□ □

CHAPTER II

Addition and Subtraction

1. Addition in Algebra is much the same as addition in Arithmetic. Suppose Hari buys 3 pencils and again 4 pencils more.

3 pencils $=$ 1 pencil $+$ 1 pencil $+$ 1 pencil

4 pencils $=$ 1 pencil $+$ 1 pencil $+$ 1 pencil $+$ 1 pencil.

Thus 3 pencils $+$ 4 pencils

$=$ 1 pencil $+$ 1 pencil $+$ 1 pencil $+$ 1p encil $+$ 1 pencil $+$ 1 pencil $+$ 1 pencil
$=$ 7 pencils. *Ans.*

In Algebra, these can be written as—

$3x=x+x+x$ and $4x=x+x+x+x$

$\therefore\ 3x+4x=x+x+x+x+x+x+x=7x.$ *Ans.*

Note that $3x$ and $4x$ are like terms and their co-efficients are 3 and 4 and the result of addition is $7x$.

Thus for adding like terms, we get the following :

Rule. Add the numerical co-efficients and affix the common letter or letters.

Def. The result of adding two or more quantities is called their **sum**.

Ex. 1. Add together x, $3x$, $6x$.

Sol. x means $1x$, *i.e.*, the numerical co-efficient of x is 1.

Sum of the numerical co-efficients $=1+3+6=10$.

$\therefore\ x+3x+6x=10x.$ *Ans.*

Ex. 2. Simplify $7ab+11ab$.

Sol. Think ab as one single quantity.

The numerical co-efficient of first term is 7.

The numerical co-efficient of second term is 11.

Sum of the numerical co-efficients $=7+11=18$.

$\therefore$ Required sum $=18ab$. *Ans.*

Note. The student need not write this whole process. After a little practice the sum of like terms can be written down orally.

Exercise 7

Add together :

1. $8x, 7x$. **2.** $4c, 14c$. **3.** $6d, 11d$. **4.** $5b, 9b$.
5. $9x, 11x$. **6.** $11x, 12x$. **7.** $2ab, 3ab$. **8.** $5xy, 7xy$.
9. $5a, 7a, 19a$. **10.** $x, 15x, 20x$.

Simplify :

11. $2x+6x+x$. **12.** $ab+5ab+8ab$. **13.** $3t+15t+12t$.
14. $ab+15ab+11ab$. **15.** $abc+7abc+12abc$. **16.** $\frac{1}{2}xy+2xy+1\frac{1}{2}xy$.
17. $3\frac{1}{2}ab+2\frac{1}{2}ba+5ab$.

---

2. We cannot add pens, pencils and inkpots together because these are all unlike things. Similarly we cannot add unlike terms.

Thus the sum of $2a$ and $3b$ is $2a+3b$.

While adding many terms in Algebra, we should first group the like terms together and then add.

Ex. Find the sum of $5a$, $9b$, $7a$, $2b$.

Sol. $\text{Sum}=5a+9b+7a+2b$
$=5a+7a+9b+2b$
$=12a+11b$. *Ans.*

Note. $12a$ and $11b$ are **unlike** terms, therefore the expression $12a+11b$ cannot be reduced further.

Exercise 8

Add together—

1. $2x, 5y$. **2.** $7a, 3b$. **3.** $m, 9n$. **4.** $x, 3x, y$.
5. $5a, b, 5a$. **6.** $7a, 2a, b$. **7.** $4x, y, 11x$.

Simplify—

8. $a+c+9c$. **9.** $2a+b+15b$. **10.** $bc+9bc+5ab$.
11. $7xy+yz+10xy$. **12.** $xy+yz+3yx+2yz$. **13.** $5xa+6xa+7xa$.
14. $xh+k+9k$. **15.** $bc+9cb+14ac$.

Find the sum of

16. $153xyz, 351yzx, 315zxy$ **17.** $105pqr, 501prq, 105pq$.
18. $150abc, 11cab, bca$. **19.** $lmn, 91lm, 100lnm$.
20. $hkt, 3kht, 50kth, 4htk$.

3. Subtraction in Algebra is much the same as subtraction in Arithmetic.

Ex. 1. From 9 pencils subtract 4 pencils.

9 pencils = 1 pencil + 1 pencil + 1 pencil + 1 pencil + 1 pencil + 1 pencil + 1 pencil + 1 pencil + 1 pencil.

4 pencils = 1 pencil + 1 pencil + 1 pencil + 1 pencil

∴ 9 pencils − 4 pencils = 1 pencil + 1 pencil + 1 pencil + 1 pencil + 1 pencil

= 5 pencils. *Ans.*

Ex. 2. Subtract $4a$ from $9a$.

Just as 9 pencils − 4 pencils = 5 pencils

Similarly $9a-4a=5a$. *Ans.*

Hence for subtracting a term from another like term, we get the following rule:

Rule. Take the difference of the co-efficients and annex the common letter or letters.

We cannot take away 4 cats from 7 dogs. They are unlike. Only like things can be subtracted.

Exercise 9

Subtract:

1. $7a$ from $9a$.
2. $9x$ from $12x$.
3. $5x$ from $7x$.
4. $11m$ from $20m$.
5. $19b$ from $20b$.
6. ab from $15ab$.
7. $5lm$ from $9lm$.
8. $3xt$ from $11xt$.
9. $1\frac{1}{2}p$ from $4\frac{1}{2}p$.
10. $2\frac{1}{2}pq$ from $10pq$.
11. $7abc$ from $15abc$.
12. $15xy$ from $30xy$.

Ex. 3. Simplify $14a+3a-10a-2a$.

As 14 pencils + 3 pencils − 10 pencils − 2 pencils
= 17 pencils − 12 pencils = 5 pencils

Similarly $14a+3a-10a-2a=17a-12a=5a$. *Ans.*

Thus if in any algebraic expression out of like terms some have plus sign and some have minus sign, in order to simplify that expression first add all terms having plus sign and then add all terms having minus sign. Subtract the second result from the first.

Note. In the beginning of an expression if the first term has plus sign the sign is generally omitted. Thus when a term has no sign prefixed to it plus sign is understood to be prefixed to it.

Exercise 10

Simplify :

1. $5x+28x-6x$.
2. $4a+5a-9a$.
3. $5a-16a+16a$.
4. $x-x+7x$.
5. $103x+2x-100x$.
6. $7t-3t+3at$.
7. $110+3s-s$.
8. $13ab-12ab+ab$.
9. $6x-x-5x$.
10. $9a+0-6a$.
11. $-7abc+9cab-2bca$.
12. $-xyz-yzx-zxy$.
13. $\frac{1}{2}x-\frac{1}{3}x$.
14. $45ab-\frac{1}{4}ab+11c-\frac{c}{2}$.
15. $\frac{ab}{3}-\frac{bc}{2}-\frac{ca}{1}+ac+ab+bc$.

□ □

CHAPTER III

Multiplication and Division

1. Multiplication means repeated addition.

You know that the result of multiplying two or more quantities is called a **product**. Each quantity is called a **factor** of the product.

2. The factors of a product may be taken in any order.

To prove that $3\times4=4\times3$.

Suppose 12 paise are arranged as in the figure here.

* * * *
* * * *
* * * *

The number of paise

$=$number of horizontal rows $\times$ number of paise in each horizontal row $=3\times4$.

Also, the number of paise$=$number of vertical rows $\times$ number of paise in each vertical row$=4\times3$.

But the total number of paise is the same.

$\therefore \quad 3\times4=4\times3$. Similarly $a\times b=b\times a$

and $\quad x\times y\times z=y\times x\times z=z\times x\times y$, etc.

Hence we conclude that in a product we can change the order of factors.

3. Def. If in a product the same factor is repeated a certain number of times, the product is called the **power** of that factor and that certain number the **index**.

The second power of x is $x\times x$ and is written x^2. x^2 is read "**x squared**".

Thus x^2 is the second power of x. 2 is the index.

The third power of x is $x\times x\times x$ and is written x^3. x^3 is read "**x-cubed**".

Thus the third power of x is x^3. Here the index is 3. The fourth power of x is $x\times x\times x\times x$ and is written x^4.

x^4 is read "**x to the fourth power**" or "**x to the fourth**".

Similarly x^7 means $x\times x\times x\times x\times x\times x\times x$, and is read "**$x$ to the seventh.**" Here the index is 7.

Note 1. The first power of x is x^1. But x^1 is generally written as x, the small digit, 1 being omitted.

Note 2. The plural of "index" is "indices".

Caution. a^2 does not mean that a is to be multiplied by itself twice. "a multiplied by itself twice" means $a \times a \times a$.

a^2 means "product of two a's".

Ex. 1. Multiply $6a$ by 3.

Sol. Product$=6a \times 3 = 6 \times 3 \times a = 18a$. *Ans.*

Ex. 2. Find the continued product of 5, 6, b, 9, b.

Sol. Product$=5 \times 6 \times b \times 9 \times b$.

$=5 \times 6 \times 9 \times b \times b = 270b^2$. *Ans.*

Ex. 3. Simplify $9 \times x \times t \times 11t \times x$.

Sol. Expression$=9 \times x \times t \times 11t \times x$

$=9 \times 11 \times t \times t \times x \times x$

$=99t^2x^2$. *Ans.*

Note. In a product the numerical co-efficient should be written down first and then the letters in their alphabetical order.

Exercise 11

Write in the simplest form :

1. $5 \times 9a$. **2.** $8 \times 9 \times b$. **3.** $4 \times 4 \times c$. **4.** $9 \times a \times 1$.

5. $5k \times 5$. **6.** $6a \times a \times 6$.

Multiply :

7. $5l$ by 2. **8.** $6a$ by 7. **9.** a by b. **10.** $2h$ by $2k$.

11. m by n. **12.** x by x.

Simplify :

13 $m \times n \times l$. **14.** $10 \times 10 \times a \times b$ **15.** $1 \times 15a \times x$.

16. $x^2 \times 5x$. **17.** $xb \times bx$. **18.** $a \times b \times 3c$.

19. $4 \times 2a \times x$. **20.** $11l \times 11m \times 11n$. **21.** $2a \times 12c \times 7h$.

22. $a \times 3 \times x \times t \times x$. **23.** $lll + mnm + mnn$. **24.** $t \times t \times t \times kkk$.

25. $lm \times nm + ln$.

26. Write in symbols :

(*i*) 'x squared' plus 'two'. (*ii*) 'a to the fourth' by 'four'.
(*iii*) 'b cubed' minus 'a to the fifth'.
(*iv*) 'l squared' plus 'm cubed'.

27. Read the following :

(*i*) $l^2 - m^5 + n^3$. (*ii*) $5h^2k^3 - t^3$ (*iii*) $y^5x^5 + 9z^5 - 7k^3$,
(*iv*) $91x^5y^5 - 19y^3z^3$.

4. To prove that zero $\times$ any number $=0$.

0×2 means $0+0=0$ $\quad$ 0×3 means $0+0+0=0$

0×4 means $0+0+0+0=0$.

Similarly any number $\times 0=0$.

Thus when zero is multiplied by any number, the product is zero, *i e.,* if one factor is zero the product is zero.

Ex. $0\times a=0$, $0\times a\times b=0$, $0\times abc=0$.

Ex. 1. Simplify (*i*) $x^3.x^4$. $\quad$ (*ii*) $x.x^4.x^5$.

Sol. (*i*) $x^3=x\times x\times x$ $\quad$ $x^4=x\times x\times x\times x$,

$$\therefore \quad x^3.x^4=x^3\times x^4$$

$$=x\times x\times x\times x\times x\times x\times x \qquad \text{[Seven factors}$$

$$=x^7. \quad Ans.$$

(*ii*) $x=x$ $\quad$ $x^4=x\times x\times x\times x$

$x^5=x\times x\times x\times x\times x$

$$\therefore \quad x.x^4.x^5=x\times x^4\times x^5.$$

$$=x\times x\times x\times x\times x\times x\times x\times x\times x\times x \qquad \text{[Ten factors}$$

$$=x^{10}. \quad Ans.$$

Notice that $\quad x^3\times x^4=x^{3+4}=x^7$.

also $\quad x\times x^4\times x^5=x^1\times x^4\times x^5=x^{1+4+5}=x^{10}$.

It shows that the index of the product of two or more factors which are powers of the same quantity is the sum of their indices.

Ex. 2. Simplify $3a\times k\times 7k^2\times a$

Sol. Product $=3a\times k\times 7k^2\times a$ $\quad =3\times 7\times a\times a\times k\times k^2$

$=21a^2k^3$. $\quad$ *Ans.*

Exercise 12

1. Simplify :

(*i*) $a^5\times a^4$. $\quad$ (*ii*) $b^5\times b^5$. $\quad$ (*iii*) $x^{10}\times x^7$.

(*iv*) $x^2.x^3.y^4.y^6$. $\quad$ (*v*) $5x^2\times 5y^2\times 2z^5\times 2a^5$.

2. (*i*) Distinguish between :

"four multiplied by a" and "a to the fourth".

(*ii*) Are $5a^2$ and $2a^5$ like terms ?

3. Find the product :

(*i*) $3x^4\times 5x^2\times y$. $\quad$ (*ii*) $x^3\times 3x^4\times 6y^2$. $\quad$ (*iii*) $x^4\times 5y^7\times y^3\times x^2$.

(*iv*) $6a\times 5b^2\times a^5\times 3b$ $\quad$ (*v*) $4a^3\times 3b\times a^5\times b^3\times 5c$.

5. In Arithmetic, we have $72 \div 8 = 9$.

Here 72 is the dividend, 8 the divisor and 9 the quotient.

Note. $72 \div 8$ may be written as $8 \times 9 \div 8$ or $\frac{8 \times 9}{8}$.

Thus $\frac{8 \times 9}{8} = 9.$ Similarly $\frac{a \times b}{a} = b.$

where $a \times b$ is the dividend, a the divisor and b the quotient.

Similarly, observe that

$$x^5 \div x^3 = \frac{x^5}{x^3} = \frac{x \times x \times x \times x \times x}{x \times x \times x} = x \times x = x^2, \text{ or } x^{5-3}.$$

$$x^9 \div x^6 = \frac{x^9}{x^6} = \frac{x \times x \times x \times x \times x \times x \times x \times x \times x}{x \times x \times x \times x \times x \times x}$$

$$= x \times x \times x = x^3, \text{ or } x^{9-6}.$$

Thus we have the following :

Rule. When a power of a quantity is divided by a lower power of the same quantity, the index of the quotient is equal to the index of the dividend diminished by the index of the divisor.

Ex. 1. Divide $7x$ by x.

Sol. $7x \div x = \frac{7x}{x} = \frac{7 \times x}{x} = 7.$

Ex. 2. Divide $12x$ by 6.

Sol. $12x \div 6 = \frac{12x}{6} = \frac{12 \times x}{6} = \frac{2 \times 6 \times x}{6} = 2 \times x = 2x.$

Ex. 3. Divide $6a^4b^3$ by $3ab^2$.

Sol. $6a^4b^3 \div 3ab^2 = \frac{6 \times a^4 \times b^3}{3 \times a \times b^2}$

$$= 2 \times a^{4-1} \times b^{3-2} = 2 \times a^3 \times b^1 = 2a^3b.$$

Ex. 4. Divide $12l^3m^2$ by $6lm$.

Sol. Required quotient $= \frac{12l^3m^2}{6lm} = 2l^{3-1} \times m^{2-1} = 2l^2m.$ *Ans.*

Exercise 13

Divide :

1. $9x$ by 9.
2. $25b$ by 5.
3. $120a$ by 12.
4. $50b^2$ by 50.
5. $21c$ by c.
6. $24a$ by a.

7. $16l$ by $4l$

8. a^2 by a.

9. $9a^2$ by a.

10. $10x^2$ by x.

11. ab by a.

12. $b \times a$ by ab.

13. $25kh$ by h.

14. lmn by l.

15. a^2b^2 by ab.

16. a^2b by a.

17. t^2q^2 by qt.

18. a^2x^3 by xa.

Simplify :

19. $a^{10} \div a^8$.

20. $b^{13} \div b^7$.

21. $51a^2 \div 17a$.

22. $12t^2a^2 \div ta$.

23. $50l^2m^2n^2 \div 5lm$.

24. $a^3b^3c^3 \div a^2b^2c^2$.

25. $21s^{31} \div 7s^7$.

Ex. 1. Express in the simplest form $64x^7y^{10}z^{12} \div 16y^9z^2x^5$.

Sol. The expression $= \dfrac{64x^7y^{10}z^{12}}{16x^5y^9z^2} = 4x^{7-5} \times y^{10-9} \times z^{12-2}$

$$= 4x^2 \times y \times z^{10} = 4x^2yz^{10}. \qquad \textit{Ans.}$$

6. An interesting result

To show that $x^0 = 1$.

Divide x^5 by x^5.

$$x^5 \div x^5 = \frac{x^5}{x^5} = \frac{x \times x \times x \times x \times x}{x \times x \times x \times x \times x} = 1.$$

Also $x^5 \div x^5 = \dfrac{x^5}{x^5} = x^{5-5} = x^0$.

Hence $x^0 = 1$.

Remember that any quantity raised to the power zero equals one.

Ex. 2. Simplify $\dfrac{16m^2y^{10}z^9 \times k^7ht}{4y^9zm^2 \times hk^7}$

Sol. Expression $= \dfrac{16m^2y^{10}z^9k^7\,ht}{4m^2y^9zk^7h}$

$$= 4m^{2-2} \times y^{10-9} \times z^{9-1} \times k^{7-7} \times h^{1-1} \times t$$

$$= 4m^0 \times y^1 \times z^8 \times k^0 \times h^0 \times t$$

$$= 4 \times 1 \times y \times z^8 \times 1 \times 1 \times t \qquad \left\{\begin{array}{l} \because m^0 = 1 \text{ and } y^1 = y. \\ k^0 = 1 \\ h^0 = 1 \end{array}\right.$$

$$= 4yz^8t. \qquad \textit{Ans.}$$

Exercise 14

Divide :

1. $10a^3b^4$ by $10a^3b^3$.

2. $45a^3b^2$ by $15a^3b^2$.

3. l^2m^2n by lm^2n.

4. $a^3b^4c^5$ by ab^4c^2.

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CHAPTER IV

Directed Numbers. Positive and Negative Quantities

1. (*i*) Ravi got a prize of 50 paise and he was fined 50 paise. His financial position remains unchanged. Here the fine of 50 paise destroys the prize of 50 paise.

Thus the fine of 50 paise and the prize of 50 paise are equal in magnitude but opposite in character.

(*ii*) If a person gains *Rs* 15 in one case and loses *Rs* 15 in another case his financial position remains unchanged. Here the loss of *Rs* 15 destroys the gain of *Rs* 15.

Thus the loss of *Rs* 15 and the gain of *Rs* 15 are equal in magnitude but opposite in character.

(*iii*) If a person ascends 20 metres and then descends 20 metres, his original position remains the same.

Here the descent of 20 metres destroys the ascent of 20 metres.

Thus the descent of 20 metres and the ascent of 20 metres are equal in magnitude but opposite in character.

From the above examples it is clear that prize and fine, profit and loss, ascent and descent, are opposite operations. In Arithmetic addition and subtraction which are opposite operations are denoted by signs + and −. Similarly in Algebra opposite quantities can be expressed by means of signs + and −.

For example Prize of *Rs* 4 may be denoted by +*Rs* 4,

then Fine of *Rs* 4 would be denoted by −*Rs* 4.

Similarly Gain of *Rs* 15 may be denoted by +*Rs* 15,

then Loss of *Rs* 15 would be denoted by −*Rs* 15.

And if Ascent of 20 metres is denoted by +20 metres, then Descent of 20 metres would be denoted by −20 metres.

Thus we find that if one quantity or movement is represented by the sign +, the opposite quantity or movement would be represented by the sign −. But by convention we represent those quantities with + sign which raise or strengthen our position and we represent such quantities with − sign which deteriorate or weaken our position.

Simplify :

5. $\frac{17a^4b^3c}{a^3b^2c}$.

6. $\frac{30l^3m^3n^3}{6l^3m^3n^3}$.

7. $\frac{81abc^3}{81ac^3b}$.

8. $\frac{42hk^2t^2}{hk^2t}$.

9. $\frac{351l^5m^2n^4}{39l^3mn^2}$.

10. $\frac{189l^5pq^7}{378l^5q^7}$.

11. $\frac{64x^7y^{10}z^{12}}{16x^3y^9z^2}$.

12. $\frac{442p^{12}q^2r^{18}}{884p^{10}qr^{18}}$.

□

Thus prize, profit, ascent, rise in temperature above zero etc., are marked + and fine, loss, descent, fall in temperature, etc., are marked −.

The profit and loss are reckoned from the original financial position of a man. The ascent and descent are measured from the original fixed position of a man. The rise and fall of a temperature are reckoned from zero degree.

This shows that we always measure the magnitude of quantities opposite in character from a particular position. This particular pasition is called the *Starting Point* and the numbers indicating the magnitude and direction are named **Directed Numbers.**

Thus we find that in Algebra signs + and − may be used for two purposes.

Firstly, they may be used, as in Arithmetic, to denote operations of addition and subtraction.

e.g., $9+4$ means that 4 is to be added to 9.

and $10-6$ means that 6 is to be subtracted from 10.

Secondly, they may be used to represent two opposite quantities. This use of signs + and − is peculiar to Algebra and is not used in Arithmetic.

Def. A positive quantity is that quantity which has sign + prefixed to it.

A negative quantity is that quantity which has sign − prefixed to it.

$+10$ is a positive quantity.

-10 is a negative quantity.

Note. When a quantity has no sign prefixed to it, plus sign is understood to be prefixed to it.

Def. Quantities which have the same sign are said to have **like signs.**

e.g., $+x$ and $+y$ have like signs.

$-x$ and $-y$ have like signs.

Quantities which have different signs are said to have unlike signs.

e.g., $+x$ and $-y$ have unlike signs.

$-x$ and $+y$ have unlike signs.

Below we give some more illustrations of positive and negative quantities :

(*i*) Distances measured towards east are considered positive.

Distances measured towards west are considered negative.

(*ii*) Distances measured towards north are considered positive.

Distances measured towards south are considered negative.

(*iii*) Assets of a person are considered positive. Liabilities of a person are considered negative.

(*iv*) Dates after 0 A.D. are taken as positive.

Dates before 0 A.D. are taken as negative.

(*v*) Degrees measured above zero of a thermometer are considered positive.

Degrees measured below zero of a thermometer are considered negative.

Note. -0 and $+0$ indicate the same thing, *viz.*, zero.

Exercise 15

1. Name any three things which are equal in magnitude but opposite in character.

2. If a gain of rupees 22 be indicated by +*Rs* 22, how would you indicate a loss of rupees 22 ?

3. If a profit of rupees 75 be indicated by +*Rs* 75, how would you indicate a loss of rupees 100 ?

4. If an ascent of 51 metres be represented by +51 metres, how would a descent of 27 metres be represented ?

5. If −*Rs* 60 mean a loss of rupees 60, what would +*Rs* 50 mean ?

6. A man gained *Rs* 875 and then lost *Rs* 530. What are his net profits ?

7. A person gained *Rs* 530 and then lost *Rs* 875. What are his net profits ?

8. A girl goes 10 metres towards east and then she goes 14 metres towards west. How far is she towards the east from her starting point ?

9. I go 22 metres towards north and then go 25 metres towards south. How far am I towards the north from the starting point ?

10. A man has property worth *Rs* 850 and he owes *Rs* 450 to his creditors. What is his net property ?

11. A man has property worth 450 and he owes *Rs* 850 to his creditors. What is his net property ?

12. In a thermometer the temperature was at 97° C. When put in ice it came down to −4°C. Find through how many degrees did the temperature fall ?

13. In the day-time a thermometer indicated a temperature at 5°C. In the night it fell down by 20°C. What was the temperature indicated at night ?

14. On the centigrade thermometer the mercury was at 20°. Then it came down to −20°. Through how many degrees did the temperature fall ?

15. The Headmaster fined Mohan *Rs* 2 and gave a prize of *Rs* 2 to Sohan. Who was well off and by how much as compared with the other ?

16. If +*Rs* 80 indicate assets of rupees 80, what do the following represent

+*Rs* 80, −*Rs* 15, +*Rs* 10, −*Rs* 5.

17. What do you understand by the following negative quantities :

(*i*) A boy gets a prize of −*Rs* 4.
(*ii*) A person owes a debt of −*Rs* 1500.
(*iii*) A man spent −14 paise.
(*iv*) A girl was fined −*Rs* 4.
(*v*) I have to pay −*Rs* 10 as a debt.
(*vi*) A well is −52 metres high.
(*vii*) A mountain is −5000 metres deep.
(*viii*) A man goes −50 metres towards south.
(*ix*) A man goes −100 metres towards west.

18. An aeroplane ascended 570 metres above sea-level, then came down by 210 metres and then rose by 192 metres and then came down by 121 metres. Indicate its ascent and descent by means of directed numbers.

19. A piece of wood is floating on the surface of the sea in the following manner :

5 metres towards east, then 7 metres towards west, then 3 metres towards west and then 13 metres towards east, and then 4 metres towards west and finally 9 metres towards east. How would you indicate its movements with the help of directed numbers ?

20. A merchant earns 18 rupees on Monday. He loses 3 rupees on Tuesday, again loses 7 rupees on Wednesday but gains 10 rupees on Thursday. On Friday he neither gains nor loses. Indicate these changes in his financial position by means of directed numbers and find out the net result of his trading during these five days.

□

CHAPTER V

Insertion and Removal of Brackets

1. ( ), { }, [ ] are called **Brackets**. They are meant for the purpose that the expression within them is to be taken as a single quantity.

$9 \times (7-3)$ means that first subtract 3 from 7 and multiply the remainder by 9.

$\therefore \; 9 \times (7-3) = 9 \times 4 = 36.$

Notice that $9 \times 7 - 3$ is not the same thing as $9 \times (7-3)$ for $9 \times 7 - 3 = 63 - 3 = 60$.

Sometimes a line called **bar** or **vinculum** drawn above the terms serves the purpose of a bracket. Thus, $9 \times (7-3)$ may be written as $9 \times \overline{7-3}$.

( ) is called a **circular** bracket.

{ } is called a **curly** bracket.

[ ] is called a **square** bracket.

In the continued product of brackets the sign of multiplication may be omitted, *e.g.*, $9 \times (7-3)$ may be written as $9(7-3)$.

2. **Insertion of brackets.** Take the expression $7+9-3$. Suppose we want to put it inside a bracket. It may be written as $(7+9-3)$. Similarly if we want to put the terms $9-3$ in a bracket we may write the expression as $7+(9-3)$, and the value of the expression remains unchanged.

Now take the expression $17-9-3$.

Suppose we want to put the terms $9-3$ in a bracket. Can we write it in the form $17-(9-3)$ as we did in the previous case ?

See $\quad 17-9-3=5$

and $\quad 17-(9-3)=17-6=11.$

Clearly $17-9-3$ cannot be put as $17-(9-3)$. The reason is that in this case the sign minus is placed before the bracket. When we have to insert a bracket and the sign placed before this bracket is minus, then the signs of all the terms to be placed inside the bracket must be changed. In that case a positive term should be made negative and a negative term should be made positive. In this way

$17-9-3$ may be written as $17-(9+3)$

and $a-b-c$ may be written as $a-(b+c)$

and $l+m-n$ may be written as $l-(-m+n)$.

Def. When a bracket is preceded by the sign $+$, it is called a **positive bracket**; if it is preceded by the sign $-$, it is called a **negative bracket.**

Clearly the terms can be put inside a positive bracket without changing the signs of the terms. But the terms can be put inside a negative bracket only by changing the signs of all the terms to be put inside the bracket.

Ex. Fill in the brackets :—

(*i*) $17-5+4=17-(\quad)$.

(*ii*) $17-5+4=17+(\quad)$.

(*iii*) $a+b-c=a-(\quad)$.

(*iv*) $l-m-n=l-(\quad)$.

Sol. (*i*) In this case there is a negative bracket, therefore change -5 into $+5$ and $+4$ into -4 and put them into the bracket thus

$$17-5+4=17-(5-4)$$

(*ii*) In this case there is a positive bracket. Therefore the signs of the terms to be put inside the bracket are not to be changed, -5 remains as -5 and $+4$ remains as $+4$, thus $17-5+4=17+(-5+4)$.

(*iii*) Here there is a negative bracket, thus $+b$ is to be changed into $-b$ and $-c$ is to be changed into $+c$ thus

$$a+b-c=a-(-b+c).$$

(*iv*) Here there is a negative bracket, change $-m$ into $+m$ and $-n$ into $+n$, thus

$$l-m-n=l-(m+n).$$

Exercise 16

Fill in the brackets :

1. $15-7+9=15-(\quad)$.
2. $a+b-c=a-(\quad)$.
3. $l+m-n-t=l+(\quad)$.
4. $l+m-n-t=l-(\quad)$.
5. $t+r-p-q+s=t+r-(\quad)$.
6. $t+r-p+q=t-(\quad)$.
7. $a-b+c=-(\quad)$.
8. $b-c-d+a=a-(\quad)$.
9. $5a+7b-3c+4x=4x-(\quad)$.
10. $5x+3y+11z-2=-2+3y-(\quad)$.

3. Removal of brackets.

In the last article, you learnt to insert a bracket. You can easily remove a bracket with the help of those very rules.

Just as $7+9-3$ can be written as $7+(9-3)$.

Similarly $7+(9-3)$ may be written as $7+9-3$.

And as $17-9-3$ can be written as $17-(9+3)$.

Similarly $17-(9+3)$ may be written as $17--9-3$.

Carefully observe the above statements, and you would find :

Firstly when there is a sign + before the bracket then the bracket may be removed without making any change in the expression.

Secondly when there is a sign − before the bracket, the bracket may be removed if the sign of every term within it is changed.

Ex. 1. Remove the brackets in the following expressions :

(*i*) $a-(b+c)$. (*ii*) $l+(m-n)-\{a+b\}$.

Sol. (*i*) There is sign − before the bracket. Therefore while removing the bracket the signs of all the terms inside the bracket should be changed, b would change into $-b$ and $+c$ into $-c$ thus

$$a-(b+c)=a-b-c. \quad \textit{Ans.}$$

(*ii*) First circular bracket is preceded by the sign +. Therefore the bracket may be removed without making any change in the terms inside this bracket. But the next curly bracket is preceded by the sign −, therefore this bracket can be removed only when we change the signs of all the terms inside it.

Thus $l+(m-n)-\{a+b\}=l+m-n-a-b.$ *Ans.*

Ex. 2. Simplify $15t-(11t-13t)$.

Sol. Since the bracket is preceded by the sign −, change the signs of the terms inside the bracket while removing the bracket.

$$\begin{aligned}\therefore \text{ expression} &= 15t-11t+13t\\ &= 28t-11t\\ &= 17t. \quad \textit{Ans.}\end{aligned}$$

Exercise 17

Remove the brackets and simplify if possible :—

1. $19+(4-5)$.
2. $15-(3-12)$.
3. $52-(70-100)$.
4. $-(-5-7)$.
5. $a+(b+c)$.
6. $x-(x-y)$.
7. $a-(-11a)$.
8. $y-(-y-m)-(t-h)$.

9. $a+(-b-c-d)-(p-q-r)$.

10. $(a-b)-(c-d)-(b-c)$.

11. $4a+(10a-9a)-(5a-3a)$.

12. $4x+(9a-10a)-(3a-5a)$.

13. $15y-(7y+9y)+(-11y-13y)$.

14. $t-4p-\overline{p+q}+(2t+5p)$.

15. $t-(a-b)+(b-c)+(c-a)-4x$.

16. $b+(11a)-\overline{a+5a}-7a$.

17. $a-b-\overline{a-b}+(b+a)-(a-b)$.

18. $17a-(3b+2c)-4c$.

19. $-x-x-(-x)-x$.

☐ ☐

CHAPTER VI

Simple Equations

1. Any two expressions connected by the sign of equality form an **equation.** Each of the expressions so connected is called a **side** or **member** of the equation. They are distinguished as the *left hand side* (L.H.S.) and *right hand side* (R.H.S.)

Thus (*i*) $2x+3+3x+5=5x+8$ (*ii*) $5x+9+6x-3=9x+12$ are equations.

In (*i*), if we put $x=2$,

Left hand side of the equality

$$=2\times2+3+3\times2+5=4+3+6+5=18.$$

Right hand side of the equality$=5\times2+8=10+8=18$.

Thus when $x=2$,

Left hand side of the equality equals Right hand side of the equality.

Now put $x=3$, in (*i*).

L.H.S. of the equality$=2\times3+3+3\times3+5=6+3+9+5=23$.

R.H.S. of the equality$=5\times3+8=15+8=23$.

Thus when $x=3$,

L.H.S. of the equality$=$R.H.S. of the equality.

Similarly by putting $x=1, 2, 3, 4, 5$.........etc., it would be found that—

The left-hand side of the equality is always equal to the right-hand side of the equality. Such an equation is called an **Identical Equation** or simply an **Identity.** The sign for writing an identity is $\equiv$. Thus this identity would be written as

$$2x+3+3x+5\equiv5x+8.$$

Now consider equation (*ii*). If we put $x=1$,

L.H.S. of the equality$=5\times1+9+6\times1-3=5+9+6-3=17$.

R.H.S. of the equality$=9\times1+12=9+12=21$.

Thus when $x=1$,

The L.H.S. of the equality is not equal to the R.H.S. of the equality.

Now put $x=2$, in (*ii*).

L.H.S. of the equality$=5\times2+9+6\times2-3=10+9+12-3=28$.

R.H.S. of the equality$=9\times2+12=18+12=30$.

Thus when $x=2$,

The L.H.S. of the equality is not equal to the R.H.S. of the equality.

Again put $x=3$, in (*ii*).

L.H.S. of the equality$=5\times3+9+6\times3-3=15+9+18-3=39$.

R.H.S. of the equality$=9\times3+12=27+12=39$.

Thus in this *particular* case, when $x=3$, the L.H.S. of the equality equals the R.H.S. of the equality. Similarly, by putting $x=4, 5, 6,$ ....etc. you will find that the L.H.S. of the equality does not equal to the R.H.S. of the equality. Thus the equality $5x+9+6x-3=9x+12$ is satisfied (*i.e.*, the L.H.S. equals the R.H.S.) only when $x=3$ and is satisfied by no other value of x Such an equality (*i.e.*, an equality which holds good for a particular value of the letter involved) is called a **Conditional equation** or briefly an **equation.**

Thus an **identity** is an equality which holds good for all values of the letter involved.

An **equation** is an equality which holds good for a particular value of the letter involved.

Exercise 18

Point out which of the following are identities and which are equations :

1. $5x-3-2x=3x-3$.
2. $4x=8+3x$.
3. $3x+2+2x-3=4x+1$.
4. $2+7x-3x+8-2x=10x+2$.
5. $5x-3+8=11x+3$.
6. $8x^2+2-2x+5x=8+8x^2+3x-6$.

---

2. We see that $x-2=3$ is true when $x=5$.

The value is said to **satisfy** the equation.

The process of finding that value of x which satisfies the equation is called the **method of solving the equation.**

The letter whose value is required to be found in an equation is called the **unknown quantity** or briefly the **unknown.**

The value of the unknown quantity which satisfies an equation is called a **root** of the equation.

An equation which when simplified involves one unknown and also in which the highest power of the unknown is one, is called a **simple equation.**

e.g., $5x+9=14$ is a simple equation.

Note. Simple equations are also called *Equations of the first degree* or *Linear Equations*. The unknown quantities are usually denoted by the letters x, y, z etc.

3. Solving an equation

You know that an equation is an equality which is satisfied by a particular value of the unknown. Suppose an equation is given and you are required to find out that particular value by which the equation is satisfied. A rough method would be to substitute the values 1, 2, 3, ... etc., for the unknown letter and see which value satisfies the equation. But this process would be difficult and lengthy and the method fails if the value of the unknown quantity is not an integer.

We explain below the method of solving an equation.

In solving an equation the following four *self evident truths* called **axioms** are frequently used.

Axiom 1. The equation does not change if equal quantities are added to both sides of the equation.

For example if $x-6=5$.

then $x-6+6$ will be equal to $5+6$, or x will be equal to 11.

Axiom 2. The equation does not change if equal quantities are subtracted from both sides of the equation.

For example if $x+3=5$,

then $x+3-3$ will be equal to $5-3$, or x will be equal to 2.

Axiom 3. The equation does not change if both sides of it are multiplied by the same quantity.

(**Note.** Zero is not a quantity.)

For example if, $\frac{x}{4}=3$, then $\frac{x}{4}\times 4$ will be equal to 3×4,

or x will be equal to 12.

Axiom 4. The equation does not change if both sides of the equation are divided by the same quantity.

(Note. Zero is not a quantity.)

For example if $5x=15$, then $\frac{5x}{5}$ will be equal to $\frac{15}{5}$.

or x will be equal to 3.

Now we shall solve a few examples to illustrate the use of these axioms.

Ex. 1. Solve the equation $x-9=7$.

Sol. Add 9 to both sides of the equation. Axiom (1).

$x-9+9=7+9$ $\qquad\therefore\ x=16.$ *Ans.*

Ex. 2. Solve the equation $x+7=19$.

Sol. Subtract 7 from both sides of the equation. (Axiom 2).

$x+7-7=19-7$. $\therefore$ $x=12$. *Ans.*

Ex. 3. Solve the equation $\frac{x}{8}=3$.

Sol. Multiply both sides of the equation by 8. (Axiom 3).

$\frac{x}{8}\times 8=3\times 8$. $\therefore$ $x=24$. *Ans.*

Ex. 4. Solve the equation $11x=66$.

Sol. Divide both sides of the equation by 11. (Axiom 4).

$\frac{11x}{11}=\frac{66}{11}$. $\therefore$ $x=6$. *Ans.*

Exercise 19

Solve the following equations :

1. $x-2=5$.
2. $x+2=4$.
3. $x-7=0$.
4. $3x=12$.
5. $\frac{x}{3}=3$.
6. $x+3=0$.
7. $5x=10$.
8. $4x=16$.
9. $7x=21$.
10. $13x=65$.
11. $\frac{x}{3}=7$.
12. $\frac{x}{7}=13$.
13. $\frac{x}{9}=9$.
14. $\frac{x}{1}=1$.
15. $13x=22$.
16. $10x=25$.

Sometimes more than one axioms have to be used to solve an equation as shown in the examples given below :

Ex. 1. Solve the equation $5x-3=17$.

Sol. Add 3 to both sides of the given equation.

$5x-3+3=17+3$ *i.e.*, $5x=20$. (Axiom 1)

Now divide both sides of this equation by 5.

$\frac{5x}{5}=\frac{20}{5}$ $\therefore$ $x=4$. *Ans.* (Axiom 4)

Ex. 2. Solve the equation $\frac{x}{4}+2=16$.

Sol. Subtract 2 from both sides of the given equation. (Axiom 2)

$\therefore$ $\frac{x}{4}+2-2=16-2$ *i.e.*, $\frac{x}{4}=14$.

Now multiply both sides of this equation by 4. (Axiom 3)

$$\frac{x}{4}\times 4=14\times 4. \qquad \therefore \quad x=56. \quad \textit{Ans.}$$

Ex. 3. Solve the equation $3x+14=2$.

Sol. Subtracting 14 from both sides of the given equation.

$$3x+14-14=2-14 \quad \textit{i.e.,} \quad 3x=-12.$$

Now divide both sides of this equation by 3,

$$\frac{3x}{3}=\frac{-12}{3}. \qquad \therefore \quad x=-4. \quad \textit{Ans.}$$

Exercise 20

Solve the following equations :

1. $2x+3=13$.
2. $3x-2=10$.
3. $3x-7=20$.
4. $5x+7=42$.
5. $4x-21=-1$.
6. $13x-70=+8$.
7. $\frac{x}{2}+3=3$.
8. $\frac{x}{8}-2=5$.
9. $\frac{x}{31}-4=10$.
10. $\frac{x}{8}-11=13$.
11. $\frac{x}{5}+50=100$.
12. $2x+3x+4x=6-15+18$.
13. $7x-8x+2x=10+1+3-22$.
14. $5x-1=2x+9$.
15. $4x+6=2x+11$.

□

Test Papers

Paper 1

1. Rewrite the following using symbols :
   (*a*) Twice a equals b. (*b*) The sum of a and b divided by c.
2. State the following in words :
   (*i*) $\frac{7x}{3}=35$. (*ii*) $p+q-r=s$.
3. If $a=15$ and $b=8$, find the value of
   (*i*) $ab+a-b$, (*ii*) $\frac{a}{b}+\frac{b}{a}$.
4. If $a=1$, $b=2$, $c=3$, find the value of
   (*i*) $a^2+b^2+c^2$. (*ii*) $\frac{1}{4}a+\frac{1}{2}b+\frac{3}{4}c$.
5. Simplify : (*a*) $2a+5a+9$. (*b*) $6xy-3yx$.

Paper 2

1. If $x=2$, $y=3$, $z=0$, find the value of
   (*i*) $xy+yz-zx$. (*ii*) $2x+y^2+3z^3$.
2. Simplify :
   (*a*) $x+2x+7x$. (*b*) $7a+b+5b+4a$.
3. (*a*) Subtract $3x$ from $10x$. (*b*) Subtract $5ab$ from $20ba$.
4. Multiply : (*a*) $3x$ by $5y$. (*b*) $2ab^3$ by $7ab$.
5. Divide : (*a*) $27a$ by 9. (*b*) $5x^2y^3z^5$ by xyz^3.

Paper 3

1. Simplify : (*a*) $a+(b-c)$. (*b*) $x-(2y+3z)$.
2. Simplify : (*a*) $p\times q\times r$. (*b*) $5x\times 7y\times 10$.
3. Divide : (*a*) $32ax$ by $16a$. (*b*) $7a^2b^3$ by a^2b.
4. Find the sum of : (*a*) $6x$, $3x$, $5x$. (*b*) xy, $2xy$, $3yx$.
5. Subtract : (*a*) $7ab$ from $10ba$. (*b*) $\frac{3}{4}xyz$ from $5xyz$.

Paper 4

1. (*i*) Find the difference between 46 and 64.
   (*ii*) What is the difference between xy and yx ?

2. Find the sum of : $7xy$, $8yz$, $15yx$, $3zy$.

3. Simplify : $2a+(3b-c)-2(a+b)$.

4. Multiply $7x^2y$ by $8xy^3$.

5. Solve the equation : $3x+2=x+8$.

Paper 5

1. (*i*) Find the difference between 76 and 7×6.

   (*ii*) What is the difference between pq and $p \times q$?

2. Subtract $8x^3y$ from $17x^3y$. 3. Divide $25p^3q$ by $5pq$.

4. Solve the equation : $5(x+3)-(x+2)=3x+25$.

5. Remove the brackets and simplify :

$$4x-2(y+z)+3x+(3z+4y).$$

Paper 6

1. (*i*) Express in words : $7lm-2xy \div 3$.

   (*ii*) If $a=28$, $b=6$; find the value of $\frac{2a+3b}{a-b}$.

2. Multiply $7x^8y$ by $3xy^2z$.

3. Solve the equation $\frac{x}{3}-5=15$ and verify your answer.

4. Simplify : $6ab+4ba+7-ab+3$.

5. Remove the brackets and simplify :

$$x-(-y-x-z)+(x-y-z).$$

Paper 7

1. (*i*) Rewrite using words for symbols : $2a+b \times c \div 3a$.

   (*ii*) If $x=4$, $y=5$; find the value of $\frac{3xy-2y}{x+y}$.

2. Subtract $8l^2mn^2$ from $19l^2mn^2$. 3. Divide $135x^3y^8z$ by $15xy^6z$.

4. Simplify : $3y+(25x-2y)-(10x-3y)$.

5. Solve the equation : $\frac{4x}{3}+18=22$.

Paper 8

1. Add together : $5x$, $7x$, $6y$, x.

2. Subtract $\frac{1}{6}abc$ from $\frac{2}{7}abc$. 3. Multiply $8a^2b^2$ by $7c^2d^2$.

4. Divide $7x^2y^3z^4$ by xy^2z^3.

5. Remove the brackets and simplify as far as possible :

$$3(x+y)+(2x-z)-(x+2y).$$

Paper 9

1. Subtract $77a^2b$ from $100ba^2$.   2. Multiply $3a^4b^2c$ by $5ab^3c^7$.
3. Divide $15x^4y^2z^5$ by $5xy^2z^3$.
4. Simplify : $5xyz+7xzy-3xyz+47$.
5. Solve for x : $\frac{2}{5}x+33=63$.

Paper 10

1. Write the following using symbols :

Three times the product of x and y diminished by 4 times p and the whole divided by 5 times the sum of l and m.

2. If $x=5$, $y=3$, $z=4$, find the value of $4x^2yz+3xy^3z\div\frac{2xy}{z}$.
3. Simplify : $5x^2y^3\times x^3y^2\times 1$.
4. Simplify : $7(x+y)+3(y-z)+\overline{2x+3z}$.
5. Solve : $7x-25+2x+9=5x+2+3x$.

□

Answers

Exercise 1

1. (*i*) $7+5$. (*ii*) $x+y$. (*iii*) $8+3$. (*iv*) $a+b$.
(*v*) $8+1$. (*vi*) $m+l$.

2. (*i*) $5-3$. (*ii*) $x-y$. (*iii*) $10-3$. (*iv*) $l-m$.
(*v*) $8-2$. (*vi*) $q-p$.

3. (*i*) $14-8$. (*ii*) $b-a$.
4. (*i*) $5+11-9$. (*ii*) $a+b-c$.

5. (*i*) $7+4+2$. (*ii*) $l+m+n$.
6. (*i*) $14-1-2$. (*ii*) $x-l-m$.

7. (*i*) 9×6. (*ii*) $p\times q$.
8. (*i*) 15×2. (*ii*) $a\times b$.

9. (*i*) $21\div 7$. (*ii*) $x\div y$.

10. (*i*) $\frac{7}{5}$. (*ii*) $\frac{l}{m}$.
11. (*i*) $\frac{8}{11}$. (*ii*) $\frac{p}{q}$.

12. (*i*) $4\times 5=20$. (*ii*) $4x=y$.
13. (*i*) $7\times 4\div 2$. (*ii*) $xy\div z$.

14. (*i*) $8>2$. (*ii*) $l>m$.
15. (*i*) $12<2\times 14$. (*ii*) $p<2q$.

16. (*i*) $8\neq 10$. (*ii*) $a\neq b$.
17. (*i*) $3\times 5\neq 18$. (*ii*) $3p\neq q$.

18. (*i*) $5+17-12=10$. (*ii*) $a+b-x=y$.

19. (*i*) $11l\div m=p$.
20. $\frac{2ab}{x+y}$.
21. $\because\ 5x=20$. $\therefore\ x=4$.

22. $(p+q)\div a$.
23. $x\sim y<p+q$.

24. $2p+q\times r-s$.
25. $\frac{p}{q}>x$.

Exercise 2

1. (*i*) Five plus four. (*ii*) *l* plus *m*.
2. (*i*) Two minus three plus four. (*ii*) *a* minus *b* plus *c*.
3. (*i*) Six minus two. (*ii*) *x* minus *y*.
4. (*i*) Five into four. (*ii*) *p* into *q*.
5. (*i*) Seven into nine. (*ii*) *l* into *m*.
6. (*i*) Nine minus two minus five. (*ii*) *p* minus *q* minus *r*.
7. (*i*) Two over three. (*ii*) *p* over *q*.
8. (*i*) Two divided by nine. (*ii*) *x* divided by *y*.
9. (*i*) Four into one upon three. (*ii*) *a* into one upon *b*.
10. (*i*) Two into three divided by five. (*ii*) *p* into *q* divided by *r*.

11. (*i*) Five into three whole divided by two.
(*ii*) p into q whole divided by r.
12. (*i*) Five into two upon seven. (*ii*) a into b upon c.
13. (*i*) Seven greater than two. (*ii*) x greater than y.
14. (*i*) Five less than nine. (*ii*) a less than b.
15. (*i*) Since five times x equals twenty-five therefore x equals five.
16. (*i*) Three into six equals eighteen. (*ii*) a into b equals c.
17. a is less than b is less than c.
18. p is greater than q is greater than r. **19.** a into b into c.
20. a into b plus b into c plus c into a whole upon two.
21. l into m minus p into q whole upon x into y plus a into b.
22. p into q into t upon h.
23. Two into p minus q into r divided by s.
24. l over m is greater than p over q.

Exercise 3

1. (*i*) No. (*ii*) Yes. (*iii*) Yes. (*iv*) No. (*v*) Yes. (*vi*) Yes.
2. 26. **3.** No difference. **4.** 9. **5.** No difference.
6. $\frac{l}{mn}$, $\frac{ln}{m}$.

Exercise 4

1. (*i*) 11. (*ii*) 4. (*iii*) 21. (*iv*) 11.
2. (*i*) 2. (*ii*) 5. (*iii*) 18.
3. (*i*) 15. (*ii*) 0. (*iii*) 36. (*iv*) 3.
4. (*i*) 4. (*ii*) 5. (*iii*) 2. (*iv*) 2.
5. (*i*) 29. (*ii*) 18. (*iii*) 16. (*iv*) 63.
(*v*) $1\frac{1}{7}$. (*vi*) $2\frac{1}{4}$.
6. (*i*) 79. (*ii*) 9. (*iii*) $1\frac{1}{4}$. (*iv*) 2.
7. (*i*) 18. (*ii*) 30. **8.** (*i*) 6. (*ii*) $\frac{11}{18}$.
9. (*i*) $19\frac{1}{4}$. (*ii*) $16\frac{2}{3}$. **10.** (*i*) $1\frac{23}{24}$. (*ii*) $10\frac{7}{10}$.

Exercise 5

1. (*i*) 5, 11, 17, 20, 1. (*ii*) 1, 15, 22, 100. (*iii*) 4, 1, 2, 5.
2. (*i*) a, $+b$, two terms. (*ii*) a, $-b$, two terms.
(*iii*) $a \times b$, $+c$, two terms. (*iv*) a, $+b$, $-c$, three terms.
(*v*) $a \div b$, $-c \times d$, two terms. (*vi*) a, $-b$, $-c$, $+d$, four terms.
3. (*i*) Simple. (*ii*) Compound. (*iii*) Simple.
(*iv*) Compound. (*v*) Simple. (*vi*) Compound.

4. (*i*) Binomial. (*ii*) Binomial. (*iii*) Trinomial.
(*iv*) Trinomial. (*v*) Binomial. (*vi*) Binomial.

5. (*i*) $a, +4a, -3a$. (*ii*) $-bc, -9bc$.
(*iii*) $4mnh, -9hnm, +7nml, 11mln$.
(*iv*) $l, -l, -4l$; $+lm, +ml$.

Exercise 6

1. 50. **2.** 100. **3.** 540. **4.** 1800. **5.** 486.
6. 324. **7.** $\frac{1}{3}$. **8.** $1\frac{1}{2}$. **9.** $\frac{2}{9}$. **10.** $\frac{1}{12}$.
11. $\frac{20}{81}$. **12.** $312\frac{3}{7}$. **13.** 9. **14.** 8. **15.** 81.
16. 375. **17.** 3072. **18.** 31104. **19.** $x^2=x\times x$; $2x=2\times x$.
20. $3x^4=3\times x\times x\times x\times x$; $4x^3=4\times x\times x\times x$.
21. Three times $x=3x$, x cubed$=x^3$; 15, 125.
22. 5 times p cubed$=5p^3$, thrice p to the fifth power$=3p^5$; 40, 96.

Exercise 7

1. $15x$. **2.** $18c$. **3.** $17d$. **4.** $14b$. **5.** $20x$.
6. $23x$. **7.** $5ab$. **8.** $12xy$. **9.** $31a$. **10.** $36x$.
11 $9x$. **12.** $14ab$. **13.** $30t$. **14.** $27ab$. **15.** $20abc$.
16. $4xy$. **17.** $11ab$.

Exercise 8

1. $2x+5y$. **2.** $7a+3b$. **3.** $m+9n$. **4.** $4x+y$.
5. $10a+b$. **6.** $9a+b$. **7.** $15x+y$. **8.** $a+10c$.
9. $2a+16b$. **10.** $10bc+5ab$. **11.** $17xy+yz$. **12.** $4xy+3yz$.
13. $18xa$. **14.** $xh+10k$. **15.** $10bc+14ac$.
16. $819xyz$. **17.** $606\,pqr+105\,pq$. **18.** $162\,abc$.
19. $101lmn+91lm$. **20.** $58hkt$.

Exercise 9

1. $2a$. **2.** $3x$. **3.** $2x$. **4.** $9m$. **5.** b.
6. $14ab$. **7.** $4lm$. **8.** $8xt$. **9.** $3p$. **10.** $7\frac{1}{2}\,pq$.
11. $8abc$. **12.** $15xy$.

Exercise 10

1. $27x$. **2.** 0. **3.** $5a$. **4.** $7x$. **5.** $5x$.
6. $4t+3at$. **7.** $110+2s$. **8.** $2ab$. **9.** 0. **10.** $3a$.
11. 0. **12.** $-3xyz$. **13.** $\frac{1}{6}x$. **14.** $44\frac{3}{4}ab+10\frac{1}{2}c$.

15. $\frac{4ab}{3}+\frac{bc}{2}$.

Exercise 11

1. $45a$. **2.** $72b$. **3.** $16c$. **4.** $9a$. **5.** $25k$.
6. $36a^2$. **7.** $10l$. **8.** $42a$. **9.** ab. **10.** $4hk$.
11. mn. **12.** x^2. **13.** mnl. **14.** $100ab$. **15.** $15ax$.
16. $5x^3$. **17.** b^2x^2. **18.** $3abc$. **19.** $8ax$. **20.** $1331lmn$.
21. $168ach$. **22.** $3ax^2t$. **23.** $l^3+m^2n+mn^2$. **24.** t^3+k^3.
25. lm^2n+ln.
26. (*i*) x^2+2. (*ii*) $a^4\div 4$. (*iii*) b^3-a^5. (*iv*) l^2+m^3.
27. (*i*) "*l* squared" minus "*m* to the fifth" plus "*n* cubed".
(*ii*) "Five *h* squared into *k* cubed" minus "*t* squared".
(*iii*) "*y* to the fifth into *x* to the fifth" plus "nine *z* to the fifth" minus "seven *k* cubed".
(*iv*) "Ninety-one *x* to the fifth into *y* to the fifth" minus "nineteen *y* cubed into *x* cubed."

Exercise 12

1. (*i*) a^9. (*ii*) b^{10}. (*iii*) x^{17}. (*iv*) x^5y^9. (*v*) $100a^5x^2y^2z^5$.
2. (*i*) "Four multiplied by *a*" means $4a$. "*a* to the fourth" means a^4.
(*ii*) No.
3. (*i*) $15x^6y$. (*ii*) $18x^7y^2$. (*iii*) $5x^6y^{10}$. (*iv*) $90a^6b^3$.
(*v*) $60a^8b^4c$.

Exercise 13

1. x. **2.** $5b$. **3.** $10a$. **4.** b^2. **5.** 21.
6. 24. **7.** 4. **8.** a. **9.** $9a$. **10.** $10x$.
11. b. **12.** 1. **13.** $25k$. **14.** mn. **15.** ab.
16. ab. **17.** tq. **18.** ax^2. **19.** a^2. **20.** b^6.
21. $3a$. **22.** $12ta$. **23.** $10lmn^2$. **24.** abc. **25.** $3s^{24}$.

Exercise 14

1. b. **2.** 3. **3.** l. **4.** a^2c^3.
5. $17ab$. **6.** 5. **7.** 1. **8.** $42t$.
9. $9l^2mn^2$. **10.** $\frac{p}{2}$. **11.** $4x^4yz^{10}$. **12.** $\frac{p^2q}{2}$.

Exercise 15

2. −*Rs* 22. **3.** −*Rs* 100. **4.** −27 metres.
5. Gain of *Rs* 50. **6.** *Rs* 345. **7.** −*Rs* 345.
8. −4 metres. **9.** −3 metres. **10.** *Rs* 400.
11. −*Rs* 400. **12.** 101°C. **13.** −15°C.
14. 40°. **15.** Sohan *Rs* 4.
16. Assets *Rs* 80, liabilities *Rs* 15, assets *Rs* 10, liabilities *Rs* 5.

17. (*i*) Fine of *Rs* 4. (*ii*) Assets *Rs* 1500.
(*iii*) Saved 14 paise. (*iv*) Prize of *Rs* 4.
(*v*) Assets *Rs* 10. (*vi*) 52*m* deep.
(*vii*) 5000*m* high. (*viii*) 50*m* towards north.
(*ix*) 100*m* towards east.
18. $+570m-210m+192m-121m$.
19. $+5m-7m-3m+13m-4m+9m$.
20. $+Rs\ 18-Rs\ 3-Rs\ 7+Rs\ 10+Rs\ 0$; Gained *Rs* 18.

Exercise 16

1. $15-(7-9)$. 2. $a-(-b+c)$. 3. $l+(m-n-t)$.
4. $l-(-m+n+t)$. 5. $t+r-(p+q-s)$. 6. $t-(-r+p-q)$.
7. $-(-a+b-c)$. 8. $a-(-b+c+d)$. 9. $4x-(-5a-7b+3c)$.
10. $-2+3y-(--5x-11z)$.

Exercise 17

1. 18 2. 24. 3. 82. 4. 12.
5. $a+b+c$. 6. y. 7. $12a$. 8. $2y+m-t+h$.
9. $a-b-c-d-p+q+r$. 10. $a-2b+d$. 11. $3a$.
12. $4x+a$. 13. $-25y$. 14. $3t+q$. 15. $t-2a+2b-4x$.
16. $8a+b$. 17. 0. 18. $17a-3b-6c$. 19. $-2x$.

Exercise 18

1. Identity. 2. Equation. 3. Equation.
4. Equation. 5. Equation. 6. Identity.

Exercise 19

1. 7. 2. 2. 3. 7. 4. 4. 5. 9.
6. -3. 7. 2. 8. $+4$. 9. 3. 10. $+5$.
11. 21. 12. 91. 13. 81. 14. 1 15. $1\frac{9}{13}$.
16. $2\frac{1}{2}$.

Exercise 20

1. 5. 2. 4. 3. 9. 4. 7. 5. $+5$. 6. $+6$.
7. 0. 8. 56. 9. 434. 10. 192. 11. 250. 12. 1.
13. -8. 14. $3\frac{1}{3}$. 15. $2\frac{1}{2}$.

Paper 1

1. (*a*) $2a=b$. (*b*) $(a+b)\div c$.
2. (*a*) Seven times x over 3 equals 35
(*b*) p plus q minus r equals s.
3. (*i*) 127. (*ii*) $2\frac{49}{120}$. 4. (*i*) 14. (*ii*) $3\frac{1}{2}$. 5. (*a*) $7a+9$. (*b*) $3xy$.

Paper 2

1. (*i*) 6   (*ii*) 13.   2. (*a*) $10x$.   (*b*) $11a+6b$.
3. (*a*) $7x$.   (*b*) $15ab$.   4. (*a*) $15xy$.   (*b*) $14a^2b^4$.
5. (*a*) $3a$.   (*b*) $5xy^2z^2$.

Paper 3

1. (*a*) $a+b-c$.   (*b*) $x-2y-3z$.   2. (*a*) pqr (*b*) $350xy$.
3. (*a*) $2x$.   (*b*) $7b^2$.   4. (*a*) $14x$ (*b*) $6xy$.
5. (*a*) $3ab$.   (*b*) $\frac{17}{4}xyz$.

Paper 4

1. (*i*) 18.   (*ii*) No difference.   2. $22xy+11yz$.   3. $b-c$.
4. $56x^3y^4$.   5. $x=3$.

Paper 5

1. (*i*) 34.   (*ii*) No difference.   2. $9x^3y$.
3. $5p^2$.   4. $x=12$.   5. $7x+2y+z$.

Paper 6

1. (*i*) Seven times *l* into *m* minus twice *x* into *y* divided by 3. (*ii*) $3\frac{4}{11}$.
2. $21x^9y^3z$.   3. $x=60$.   4. $9ab+10$.   5. $3x$.

Paper 7

1. (*i*) Twice *a* plus *b* into *c* divided by three times *a*.   (*ii*) $5\frac{5}{9}$.
2. $11l^2mn^2$.   3. $9x^2y^2$.   4. $15x+4y$.   5. $x=3$.

Paper 8

1. $13x+6y$.   2. $\frac{5}{42}abc$.   3. $56a^2b^2c^2d^2$.
4. $7xyz$.   5. $4x+y-z$.

Paper 9

1. $23a^2b$.   2. $15a^5b^6c^8$.   3. $3x^3z^2$.
4. $9xyz+47$.   5. $x=75$.

Paper 10

1. $\dfrac{3xy-4p}{5(l+m)}$.   2. 1416.   3. $5x^5y^5$.
4. $9x+10y$.   5. $x=18$.

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